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TECHNICAL REPORT

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Communication networks and systems for power utility automation – Part 80-5: Guideline for mapping information between IEC 61850 and IEC 61158-15

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IEC TR 61850-80-5 has been prepared by IEC technical committee 57: Power systems management and associated information exchange. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
57/2622/DTR	57/2647/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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- withdrawn, or
- revised.

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INTRODUCTION

This part of IEC 61850, which is a Technical Report, provides a guideline to exchanging information between IEC 61850 and IEC 61158-6-15 (Modbus TCP). Today, industrial fields, such as distributed energy resource (wind and solar energy, etc.) and condition monitoring, have been successfully exchanging information from Modbus to IEC 61850. Although many manufacturers have already implemented the Modbus to IEC 61850 conversion device or system, these devices do not guarantee interoperability. Therefore, a consistent and unified information exchange scheme between IEC 61850 and IEC 61158-6-15 is required.

Modbus over serial line (Modbus RTU) is not part of IEC 61158-6-15, but is also considered in this technical report.

It was first foreseen to prepare this document as a Technical Specification. However, as there is a lack of feedback from practical experience, it was decided to first publish a Technical Report with a limited scope (see 57/2506/Q and 57/2553/RQ).

This is now the first edition of a Technical Report with the scope limited to the mapping of a Modbus device's register into an IEC 61850 model. It is intended to encourage first prototype implementations to get technical feedback.

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 80-5: Guideline for mapping information between IEC 61850 and IEC 61158-15

1 Scope

1.1 General

1.1.1 Scope statement

This part of IEC 61850, which is a Technical Report, specifies the mapping rules for building and configuring a system using both IEC 61850 and IEC 61158-6 (Industrial communication networks – Fieldbus specification, CPF Type 15, Modbus) protocols by utilizing gateways between IEC 61850 and IEC 61158-6 IEDs / subsystems. The objective is to enable operational run-time data exchange among these IEDs / subsystems, and to automate the configuration of a gateway as much as possible.

Please note that for the purposes of this document, "Modbus" is used to represent both serial Modbus (Modbus RTU) and IEC 61158-6 (Modbus TCP).

Within the capability of each protocol, some configuration attributes (IEC 61850-7-3:2010+AMD1:2020 attributes with functional constraint CF) are also mapped in addition to the operational real-time data.

The rules specified in this document are based on the published standards and do not make any proposed changes to IEC 61850 or 61158-6. This standard does not specify any rules for an IEC 61850 IED to directly communicate with a Modbus IED and vice versa, except through a gateway.

This document does not mandate which data items that a particular IED shall support, regardless of whether the implementation uses Modbus or IEC 61850. Instead this document provides rules specifying how a gateway maps any given data item from one protocol to the other, given that the data item is already available and is transmitted using one of the protocols.

Similarly, this document does not mandate which mapping rules a given gateway shall support. When this document is republished as a Technical Specification, conformance requirements will be identified.

This document recognizes that there will be situations in which a user will require that a gateway perform non-standard protocol mappings. Non-standard mappings are outside the scope of this document.

This document also recognizes that gateways typically manipulate the data passing through them in a variety of ways. Some of these functions include alarm trigger grouping, data suppression, interlocking and command blocking. Conformance to this document does not preclude a gateway from performing such functions, even though this document primarily specifies "straight through" mapping of Modbus data to IEC 61850-7-3:2010+AMD1:2020 data. Subclause 7.4 of this document describes how some of these functions may be specified to a gateway by a mapping tool using equation notation in XML. However, some of these functions may be too complex for a mapping tool to specify in an automated manner.

The mapping architecture for the exchange of the run-time information consists of four parts:

1) Conceptual architecture of a gateway and associated use case
2) Mapping of the information model (Assign semantic to the Modbus data)
3) Mapping of the data (which is in fact part of the information model)
4) Mapping of the services (out of scope for this document)

1.1.2 Areas of application

While a primary focus of this document is for electric utility industry, other industries that deliver energy and water could also use this document if they also plan to use both Modbus and IEC 61850 in their systems.

Vendors can use this document to implement and test their gateway products and be assured of their interoperability to this mapping standard. Users can use this document to specify their respective systems. System integrators can use this standard to assist in system integration and testing of user systems utilizing both protocols and gateways.

Modbus device vendors can use this document to express in a non-ambiguous manner the semantics of each of the data points exposed over the Modbus interface.

1.1.3 Benefits

This document specifies an SCL extension using a Modbus specific XML namespace to add syntax for describing the mapping of Modbus data into the IEC 61850 data model. By using this specification, Modbus devices may benefit from the full IEC 61850 ecosystem (engineering tools, engineering process, functional naming …).

This version of the document focuses on the mapping of Modbus data into the IEC 61850 semantic model and therefore expects the gateway configuration to be mapping data from a Modbus server to be exposed in an IEC 61850 server access point of the gateway.

1.1.4 Published versions of this standard and related namespace name

This document defines one namespace:

– An SCL schema namespace (SCL)

Table 1 provides an overview of the references between the published versions of this standard and the related namespace name.

Table 1 – Reference between published versions of the standard and related namespace name

Edition	Publication date	Webstore	Namespace
Edition 1.0	2023-xx	IEC TR 61850-80-5:20xx	IEC 61850-80-5:2020A2

1.2 Namespace name and version

Table 2 shows all the attributes of the XML schema namespace.

Table 2 – Attributes of xsd namespace

Attribute	Content
Namespace nameplate	
Namespace Identifier (xmlns)	http://www.iec.ch/61850/2020/SCL/80-5
XSD version header attribute	2020A2
Recommended reference name	eIEC61850-80-5
Version	2020
Revision	A
Release	2
CodeComponentName	SCL

1.3 Code Component distribution

1.3.1 General

Each Code Component is a ZIP package containing at least the electronic representation of the Code Component itself and a file describing the content of the package (IECManifest.xml).

The life cycle of a code component is not restricted to the life cycle of the related publication. The publication life cycle goes through two stages, Version (corresponding to an edition) and Revision (corresponding to an amendment). A third publication stage (Release) allows publication of Code Component in case of urgent fixes of InterOp Tissues, thus without need to publish an amendment.

Consequently, new release(s) of the Code Component may be released, which supersede(s) the previous release, and will be distributed through the IEC TC57 web site at:

http://www.iec.ch/tc57/supportingdocuments.

The latest version/release of the document will be found by selecting the file for the code component with the highest value for VersionStateInfo, e.g. IEC_TR_61850-80-5.SCL.{VersionStateInfo}.full.zip.

1.3.2 XML schema namespace code component

The SCL code component namespace is an XML schema file. It will be available in a full version. The code component includes sn XML file which is an example file.

The full version is freely accessible on the IEC website for download at http://www.iec.ch/tc57/supportingdocuments but the usage remains under the licensing conditions.

In case of any differences between the downloadable code and the IEC pdf published content, the downloadable code(s) is(are) the valid one; it may be subject to updates. See history files.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TS 61850-2:2019, *Communication networks and systems for power utility automation – Part 2: Glossary*

IEC 61850-7-2:2010, *Communication networks and systems for power utility automation – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)*
IEC 61850-7-2:2010/AMD1:2020

IEC 61850-7-3:2010, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes*
IEC 61850-7-3:2010/AMD1:2020

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*
IEC 61850-7-4:2010/AMD1:2020

IEC 61784-2:2019, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC/IEEE 8802-3*

IEC 61158-5-15:2010, *Industrial communication networks – Fieldbus specifications – Part 5-15: Application layer service definition – Type 15 elements*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

For the purposes of this document, the following terms and definitions apply.

3.1.1
Modbus Client
interface which allows the user application to explicitly control information exchange with a remote device

Note 1 to entry: The Modbus Client builds a Modbus request from parameter contained in a demand sent by the user application to the Modbus Client Interface. The Modbus Client uses a Modbus transaction whose management includes waiting for and processing of a Modbus confirmation.

3.1.2
Modbus Server
module which, on reception of a Modbus request, activates a local action to read, to write or to achieve some other actions

Note 1 to entry: The processing of these actions is done totally transparently for the application programmer. The main Modbus server functions are to wait for a Modbus request on 502 TCP port, to treat this request and then to build a Modbus response depending on device context.

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in IEC TS 61850-2, IEC 61850-7-2:2010+AMD1:2020 as well as the following apply.

GCT Gateway Configuration Tool

ICT IED Configuration Tool

SCT System Configuration Tool

MCD Modbus Configuration Description

4 Architecture of gateways between IEC 61850 and Modbus

4.1 Overview

This clause describes the conceptual architecture of gateways between IEC 61850 and Modbus. There are two basic types of gateways to be considered:

- Gateway between an IEC 61850 server IED and a Modbus client IED. This may be the case where the substation with IEC 61850 is connected to the network control center via Modbus communication.
- Gateway between a Modbus server IED and an IEC 61850 client IED. This is the case where a Modbus IED must be connected to a substation using IEC 61850.

This document will focus on the second case, because it is more common. The first case may be treated in a later edition of this document. Nevertheless, the basic principle of both gateway types is described in Subclauses 4.2 to 4.3.

4.2 Gateway between a Modbus server IED and an IEC 61850 client/subscriber IED

4.2.1 General

The generalized configuration is shown in Figure 1. It consists of several Modbus server devices, a gateway device and an IEC 61850 client device. One side of the gateway has a Modbus client interface to communicate with the Modbus server devices and the other side of the gateway has an IEC 61850 server interface for communication with the IEC 61850 client/subscriber device. The IEC 61850 communications provided by the gateway are out of scope of this document.

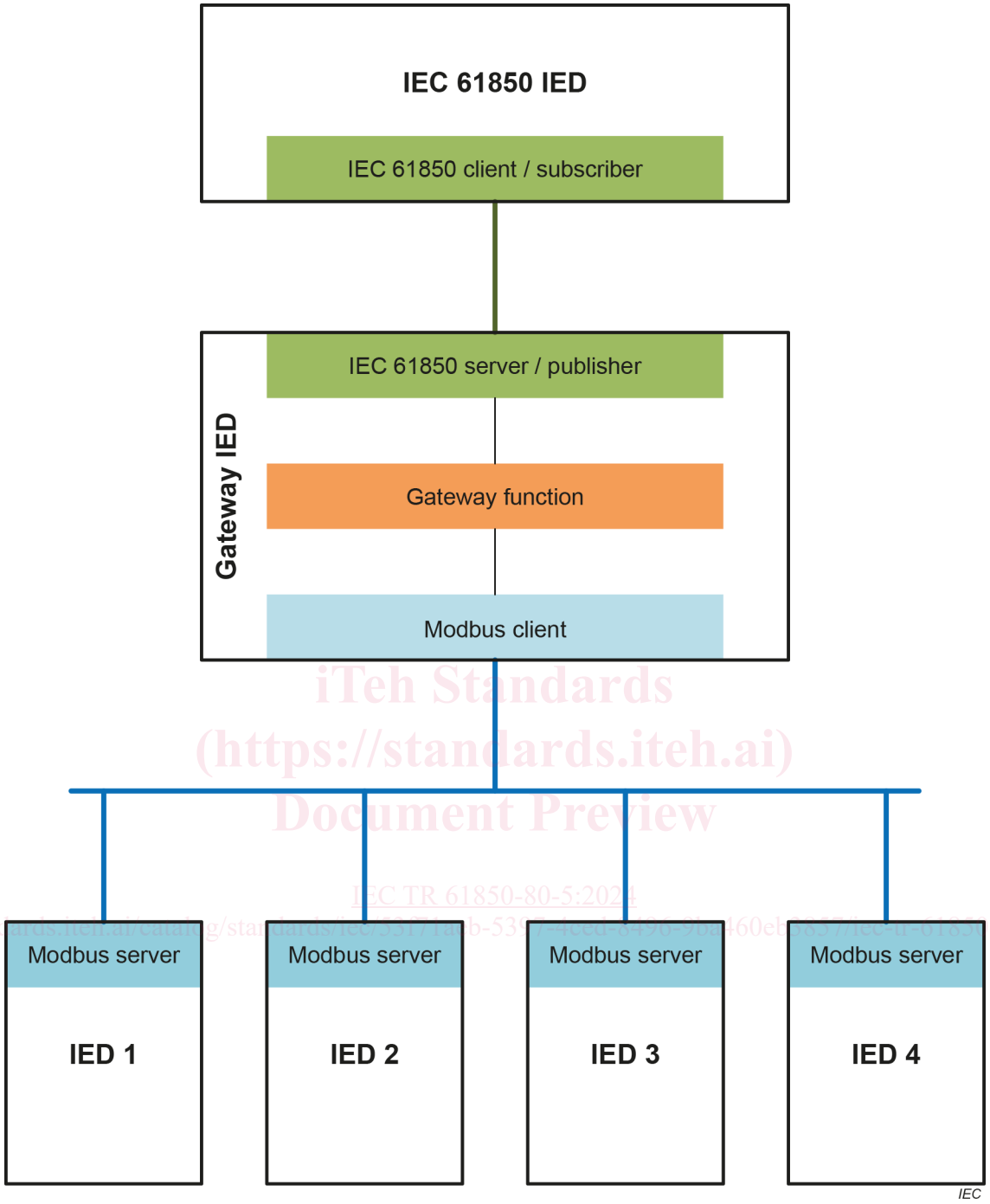

Figure 1 – Communication between a Modbus server IED and an IEC 61850 client IED

4.2.2 Gateway device

The conceptual architecture of the gateway device is shown in Figure 2. The gateway device is decoupling the IEC 61850 communication and the Modbus communication via a "Gateway function". The Gateway function may implement an IEC 61850 process data image. The advantage of this approach is that a real-time pass-through is not necessarily required for all messages. The following principles are used for the information exchanges between IEC 61850 and Modbus:

- Run-time operational information (status information, measurements) that is usually transmitted event driven is exchanged through the process data image. Data retrieval on the two networks is independent and may take place at different rates.